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ABSTRACT

As part of an effort to reassess its enrollment forecasting methodology and techniques, the Florida Division of Community Colleges conducted a national survey of state directors of community/junior colleges to identify successful forecasting practices. A conceptual framework for analyzing responses was developed from a review of the literature on enrollment projections and used to summarize the state of the art of enrollment forecasting. Four categories of approaches were identified: (1) trend extrapolation approaches, i.e., curve-fitting techniques, such as simple and moving averages, which utilize historical enrollment data as the basis for projections, and causal models, such as cohort-survival techniques, which give consideration to independent factors in addition to historic enrollment data; (2) subjective judgments, which involve the use of expert opinion or futuristic approaches; (3) combination approaches, which use both extrapolation and subjective methods; and (4) no state-level forecasting. The survey revealed that nine of the 46 responding states conducted no systematic state-level forecasting; 12 states used curve-fitting techniques; 18 states used causal models; one state based its enrollment projections solely on subjective judgment; and six states reported using combination approaches. The survey report details methodology and findings by state and concludes with observations on responsibility for, success of, and desirability of enrollment forecasting. (AYC)

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COMMUNITY COLLEGE ENROLLMENT PROJECTION STUDY

A National Survey of Approaches Used By State Agencies for Community/Junior Colleges

March 1981

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INTRODUCTION

The Florida Community College Enrollment Forecasting Project is testimony to the continuing efforts of the Division of Community Colleges to be in the vanguard of state agencies responsible for community colleges. The Division has a history of developing and perfecting procedures and methodologies for generating timely and accurate information to guide the executive and legislative branches in policy-making and resource allocation to the community colleges. Efforts to perfect enrollment projecting methodologies have been evident over the last twenty years. As recently as 1976, the Division carried out an exhaustive study of enrollment projecting/forecasting techniques and procedures as reported in the literature and as carried out by counterpart agencies throughout the country.

This report is part of the latest effort by the Division to reassess its enrollment forecasting methodology and techniques with the view of further refinement and improvement. The project essentially acknowledges the fact that forecasting is a tenuous and imperfect practice because of the array of variables, the rapidity of change, and the diversity of the environment itself. Nevertheless, enrollment forecasting must be carried out in order for any planning to be done.

This report covers one of three different interrelated efforts as part of the STAR Project. It represents the result of a national survey of state agencies responsible for public community/junior colleges. It was intended to provide a basis for comparison and to identify any successful practices which might be considered by Florida for its own forecasting system. The other two areas being carried out under the STAR Project area survey of the environmental factors or forces which impact upon enrollment forecasting at the state and/or

institutional level in Florida and a study of the relationship of various variables to the accuracy of enrollment projecting/forecasting at the state and institutional levels.

PROCEDURE

The procedure followed to carry out this part of the Project involved a letter prepared jointly by Dr. Lee Henderson and Dr. Lou Bender addressed to the State Director listed in the Directory of the National Council of State Directors of Community/Junior Colleges. The letter requested information on the enrollment forecasting approaches of the state as well as copies of any published materials relating to such enrollment forecasting. One month later a follow-up letter was sent to those states where responses had not been received reminding the Director of the study and requesting that a response to the enrollment forecasting project be made. The National Council of State Directors met in Chicago on November 3, 1980 at which meeting a personal request was made of four State Directors in attendance from whom responses had not been received. Finally, in February 1981, telephone calls were made to the remaining State Directors who had not replied and a telephone interview was carried out wherein oral descriptions of the enrollment forecasting approach of that state were provided.

A content analysis of all published materials sent as a result of letters and other requests was carried out. A conceptual framework for the analysis was developed form the literature dealing with higher education enrollment forecasting and specifically related to the works of Linns (1960), Wing (1974), Gilchrist (1976), and Anderson, et al (1977). With this framework, a table was developed to summarize the "state of the art" of enrollment forecasting as reported by the states.

Finally, telephone interviews were carried out with a few selected State Directors where documents suggested both genuine interest and a degree of sophistication in enrollment forecasting. One of the purposes of the telephone calls was to seek "expert opinion" on the effectiveness of certain approaches or techniques.

FRAMEWORK FOR ANALYSIS

The literature reflects some ambiguity in the meaning of enrollment "forecasting" and enrollment "projections". These terms frequently are used interchangeably although it appears that enrollment projection is intended to deal with quantitative measurements based on statistical techniques and predicated upon historical experience or projected into the future on the basis of selected demographic, educational, economic, or social variables. Enrollment forecasting often is presented as more encompassing than enrollment projections because both professional and technical considerations are utilized. In this context, both quantitative statistical techniques and professional judgement of future events or policies are combined to produce the forecast.

For this study, a framework for analysis was developed having four different approaches (see Table on page 16).

TREND EXTRAPOLATION APPROACHES

The first category has been classified Trend Extrapolation and involves either "curve-fitting" approaches or "causal models" as outlined by Wing (1974). Curve-fitting approaches involve models or techniques which utilize historical enrollment data primarily as the basis for producing forecasts. Causal models, on the other hand, produce forecasts on relationships between

historical data and other variables relating to future enrollments such as birth rates, high school graduates, unemployment ratios etc.

Curve-Fitting Approaches: The techniques employed under this approach assume that the past is prologue to and a reflection of the future. Implicit in such an assumption is an expectation of stability and little radical change. Wing identifies seven curve-fitting techniques including: simple averages, moving averages, exponential smoothing, first order and second order polynomial models. exponential models, and spectral analysis. Under simple averages, the average or mean of past enrollments becomes the basis for forecasting future enrollments. The polynomial models, on the other hand, combine the historical data with selected parameters resulting in curves or trends which can be examined for patterns of past enrollments which will continue into the future. The polynomial techniques could result in linear, quadratic, or more complex forms. Spectral analysis involves trigonometric functions within the equations of the polynomial model and, according to Wing, are not very appropriate for enrollment forecasting because of the need for several dozen historical data points.

Causal Models: The causal models give consideration to independent factors or variables in addition to historic enrollment data. Implicit in such models is an assumption that a relationship between enrollments and such factors exist, will be stable, and are predictable. Hence, the relationship between the number of high school graduates from graduating classes in earlier years to first time college enrollment or the ratio of minority enrollees to the general population might become factors for enrollment projections. Among the five causal models discussed by Wing are: cohort survival techniques, ratio methods, multiple correlation and regression methods, path-analytic models, and systems of equations. Under the cohort survival technique common classification traits are identified based on the assumption that the survival

patterns of a particular group in the design cohort will be in the same as those for successive years. Grade progression or class succession patterns frequently are used as well as age survival patterns from birth through college graduation. Multiple correlation and regression methods involve the relationship between enrollments (dependent variable) and one or more independent variables. The approach is similar to the polynomial model techniques except that the polynomial technique uses powers of time as the independent variable as constrasted with the multiple regression approach where a wide variety of independent variables are accommodated. The basic difference between the multiple correlation and regression models and the path-analytical models is the fact that the latter requires a priori identification of the causal relationships between the dependent variable (enrollment) and the relevant independent variables such as sex, ethnicity, grade point average, family income, etc.

The Trend Exptrapolation class has been divided into the two groups i.e. curve-fitting and causal models for the purpose of classifying the approaches now being used by state agencies responsible for community colleges throughout the country. The specific technique or combination utilized is not enumerated in this report since many states do not specify the specific technique(s) employed for enrollment forecasting.

SUBJECTIVE JUDGEMENT

Two approaches described in the literature which would fit under the subjective judgement class deal with the use of expert opinion or professional judgement. One is described as "Policy Alternatives", an approach where the assumption is that experience with the phenomenon provide the expert with an intuitive insight into future trends. The other subjective judgement approach

identified in the literature is a "Futurist Approach" where scenarios are built to predict the likelihood of occurrence based on events or trends predicted for the future. Such scenarios attempt to address the question "what if" and rely upon a subjective judgment or response.

COMBINATION APPROACH

Both Trend Extrapolation intended to identify the quantitative historical base and Subjective Judgment approaches involving "what if" are utilized in the third broad class. Several states view the futurist approach involving scenarios as an appropriate way for long-range planning forecasts which often are intended to be educational to the public or policy-makers rather than specific for appropriation or budget determination/allocation. The policy alternatives approach on the other hand, is increasingly evidenced as states attempt to provide the legislative and executive policymakers with alternative consequences of one decision versus another. As the fiscal condition of states has become more austere, some legislatures have moved toward an appropriations cap beyond which needed funding for additional enrollments would need to be generated elsewhere. Hence, the open door of access which philosophically undergirds community college education has been gradually moving toward a closed door for some. The policy alternative approach enables the state community college agency to make known the consequences of such policy decisions.

NO STATE LEVEL FORECASTING

The fourth category or class within the framework for analysis simply acknowledges the fact some states do not forecast or project enrollments. Rather, such states compile the constituent institutional projections into a

composite for the aggregate state enrollment projection used.

RESULTS

All but three states are reported under this section. Maine, Utah, and Vermont did not respond to the survey or follow-up letters and no one felt qualified to respond to the telephone inquiry.

No State Level Forecasting: Nine states including Mississippi, Montana, Nebraska, New Hampshire, New York, North Dakota, Pennsylvania, South Dakota, and Wyoming reported no systematic state level forecasting of community college enrollments. These states use the enrollment projections of the constituent institutions and compile an aggregate composite which is used for planning and appropriations purposes. Comments of the respondent in Mississippi are reflective of the general sentiment reported by these states:

> We do not make state level enrollment projections for the Mississippi Public Junior Colleges. Each junior college is requested to project two years ahead in the budgetary request process. The state office takes these estimates (with negotiable compromises if a projection is questionable) and compiles these for the statewide total.
>
> We have found that the local personnel are more sensitive to factors which affect enrollments than we can be at the state level. Local trends in job markets, secondary school enrollments and recruiting success, special emphasis and problems are some awarenesses that we lack. Further, the two state-office persons have all they can say grace over without enrollment projections.

The respondent form New York also communicated reliance upon individual college estimates:

> I rely heavily on the individual community colleges to supply me with their best estimate of enrollment in the immediate years ahead. Each community college develops a campus master plan that projects

> student enrollment, among other things. Each campus looks at the various student market within their sponsorship area, determines the percentage of that market likely to attend their particular institution on a full-and/or part-time basis, and then gives me a figure. You know all of the variables that come to bear on such predictions, but generally the community colleges have been relatively close to their enrollment targets. If anything, the colleges tend to be conservative in their estimates.
>
> After I have the campus estimates, I call each college president to further refine the figures. The campuses then become "locked" into a figure which may only be increased by me if another institution is willing to surrender some of its allotment, or if the State Legislature increased the total allotment assigned to the community colleges. The individual campus enrollment projections are simply totaled and appear as a part of the University's total request to the State Legislature. I am currently requesting that the State Legislature appropriate money in 1980-81 fiscal budget to cover an increase of 1,974 FTE's over what had been allocated to the community colleges earlier this year. This request is based on campus enrollment revision requests made to this office.

Trend Exptrapolation: Twelve states report enrollment forecasting which uses curve-fitting techniques that assume trends or patterns exist in past enrollments. Among the states are Alabama, Alaska, Georgia, Hawaii, Kansas, Kentucky, Louisiana, Missouri, Nevada, Oklahoma, South Carolina, and Texas.

In Texas two basic methods are used to forecast fall head-count enrollment including an aggregate population-based forecast based on the historical relation between enrollments and the age distribution of the states population for the same period and a dis-aggregate population-based forecast where college participation rates and county population projections are related to obtain the total projected number of students for each county for each year in the projection period. Only the aggregate population-based forecast method was used for projecting the enrollments for the public junior colleges. however.

In Hawaii assumptions are made that the community colleges will contin to receive the same percentage of the high school graduating classes as received in previous years, the same percentage of new students from out-of-state high schools and even that they will be distributed among the program areas of the community colleges as experienced in previous years. Retention rates over a five-year historical period are used for projecting the continuing and returning students for the previous fall total enrollment in the program. In South Carolina a simple ratio method is used for estimating the enrollments for a multi-year cycle. The respondent in that state observed:

> Within the TEC System, during the past six years, attempts have been made to project institutional enrollments by a number of statistical techniques but all have failed due to a lack of historical data and the variety of institutional characteristics which impact upon enrollment fluctuations. The State Office in the annual planning/budgeting development process uses a simple ratio method for estimating statewide enrollments for a multi-year cycle. For the past two years statewide FTE enrollments have declined by approximately 3% per year while headcount enrollments have remained stable. The enrollment projections which drive the agency planning/budgeting process are considered objectives to be met if funds are provided. During the past four years, state funds have provided only approximately 63% of the cost of the FTE. The System allocates the appropriation on the previous year's institutional cost and the enrollment pattern and not through an enrollment projection based formula. In the early and mid 1970's enrollment growth out paced the growth in appropriations. Student fees and local county funds bought increasing larger portions of the program cost.
>
> Sophisticated enrollment projection processes are of no benefit to the System at this time. With limited or no possibilities for additional state, county, and student resources the institutions must develop very specific strategies to

> phase out low enrollment programs and recruit for new programs. Straight line growth will only produce internal management and fiscal problems since the annual appropriations are not and will not be, in the near future, adequate to support system-wide FTE enrollment growth. Certainly, we can identify pools of people who could benefit from post-secondary educational programs but the resources to provide these expanded services are not available.

The second Trend Extrapolation approach-Causal Models- was identified for eighteen states. Causal Models were reported in use in the states of Arizona, Arkansas, California, Connecticut, Florida, Illinois, Indiana, Massachussetts, Michigan, Minnesota, New Jersey, New Mexico, North Carolina, Ohio, Oregon, Tennessee, Virginia, and Wisconsin. In Ohio the Regents Enrollment Forecasting System (REFS) is based on high school graduate pools by county, matriculation rates, institutional market shares, and historical enrollment patterns in postsecondary institutions of the state. In addition, a Demographic Simulation of Ohio (DSO) is used employing an interactive computer program to forecast population groups with anticipated college growing rates by age and sex. The DSO addresses the mortality, fertility, and migration trends of the state in establishing annual demographic figures against which enrollment projections are made.

In Connecticut multiple regression was used to determine the impact of specific variables on Connecticut enrollments after which the ratio of full-time under graduate enrollments to the number of high school graduates is calculate. Three alternative projection ranges were developed with one assuming a cumulative persistence rate from birth to high school graduation will remain essentially the same while the second predicts the number of high school graduates to enter college based on a derived ratio and the third assumes a lower cumulative persistence rate for high school graduates.

In Wisconsin examination of past enrollments is made to identify trends for projecting future enrollments based on demographic factors including eighteen-twenty-four age group enrollment, high school graduates, enrollment by age group, and enrollment by program area. These are then related to population projections for forecasting future enrollments.

While Illinois submitted a document outlining the procedure for enrollment forecasting using population projections and enrollment trends by age and sex, the respondent wrote:

> The Illinois Community College Board is not engaged in making official enrollment projections for the system of community colleges at the present time. The ICCB is in the process of developing an enrollment monitoring and forecast model for use at the state level and by the local community colleges however. This enrollment monitor and forecast model is based on the Ohio enrollment projection system developed by the Board of Regents in Ohio. In essence, this system projects enrollments based on recent enrollment trends by segments of the population such as age groups / sex. These trends are then applied to population projections by age and sex for a given area. The model is capable of utilizing changing rates as well as accompanying (sic) other variables which are deemed appropriate.
>
> During recent years, we have also studied the short-ter effects of economic factors such as high unemployment rate on community college enrollments. We have found that high unemployment rates have greater impact on community college enrollments than the number of high schoo graduates, for example.

Subjective Judgment: While many states utilize some aspect of the policy alternatives or the futurist approach, only one state could be classified as relying primarily upon subjective judgment. That state was Rhod Island and the respondent stated:

> Thank you for your recent inquiry regarding our enrollment estimating system. The Community

> College of Rhode Island (formerly Rhode Island Junior College) offers a range of Occupational/Vocational Programs as well as Arts and Science curricula. The space available in the vocational programs is limited and thus, the enrollments are stable from year to year. Enrollments in Arts and Sciences (includes liberal arts, science and business) are estimated by reviewing historical enrollment trends, revenue needs, new course offerings, course cancellations, and discussing any changes in the student market with department chairpersons, the deans, the admissions staff and the registrar. National and state level enrollment trend information is also considered. In recent years, enrollments have been increased at about 5% per year.

Combination: Six states reported systems which had elements of both the Trend Extrapolation class and the Subjective Judgment class. They were: Colorado, Delaware, Iowa, Maryland, Washington, and West Virginia. In Colorado a statewide Task Force was apppointed by the Commission on Higher Education in 1979 to develop a statewide enrollment forecasting methodology. The Task Force recommended that a group process be utilized in enrollment forecasting, that an annual recurring data collection and analysis be maintained, that certain principles be followed consistently when carrying out the annual enrollment forecasting porcess and that the supporting data and projection techniques for the state be constantly updated and refined. The Colorado Task Force observed:

> In order to serve as both a predictive tool and a planning aid, a forecasting methodology should incorporate (a) at least several kinds of techniques; (b) several levels of aggregated higher education enrollment and associated data; and (c) widespread on-going involvement and input from designated higher education representatives, interested state agency staff members, members of the economic and population forecasting sile of business and government and other public and private agencies.

The West Virginia Board of Regents, responsible for all segments of public higher education utilized Trend Extrapolation strategies as well as policy

alternatives and futurist approaches according to their report.

Futhermore, the report observes:

> The enrollment projections set forth herein are goals as well as projections. They hypothesize the continued growth of very recent years in college-going rates since such growth is adjudged to be in the best interests of West Virginia and its citizens. They assume a continued growth in older citizen college attendance as has been in evidence over the past three or four years. They assume that financial resources will be available to fund the necessary programs needed by the increasingly diverse types of college and university attendance.

In Iowa a study of enrollment forecasting methodologies was carried out by the University of Iowa as part of a commissioned statewide enrollment projection for the years 1977-90 in behalf of the House Budget Committee of the Iowa General Assembly. The Iowa Study also utilized trend extrapolation, policy alternatives and the futurist approach in what it called a "non-prescriptive projection model." The intent was for the model to accommodate different trend variables which might be applied at different times and in response to different assumptions. The Iowa model was constructed on a computer system whereby an interactive format makes several separate projections possible within a short

TABLE

Enrollment Forecasting Approaches Reported
by State Agencies For Community Junior Colleges

I. TREND EXTRAPOLATION APPROACHES

A. Curve Fitting Techniques such as Simple Averages, Moving Averages, Exponential Smoothing, Polynomial Models and Exponential Models.

12 States: Alabama, Alaska, Georgia, Hawaii, Kansas, Kentucky, Louisiana, Missouri, Nevada, Oklahoma, South Carolina, and Texas.

B. Causal Models such as Cohort-Survival Techniques, Ratio Methods, Path-Analytical Models and Systems of Equations.

18 States: Arizona, Arkansas, California, Connecticut, Florida, Illinois, Indiana, Massachusetts, Michigan, Minnesota, New Jersey, New Mexico, North Carolina, Ohio, Oregon, Tennessee, Virginia, and Wisconsin.

II. SUBJECTIVE JUDGMENT APPROACHES

Policy Alternative and/or Futurist Approach Wherein Expert Opinion Is Employed.

1 State: Rhode Island

III. COMBINATION OF TREND EXPTRAPOLATION AND SUBJECTIVE JUDGMENT APPROACHES

6 States: Colorado, Delaware, Iowa, Maryland, Washington, and West Virginia.

IV. NO STATE LEVEL FORECASTING: COMPILE 7 USE CONSTITUENT Institution's Projections.

9 States: Mississippi, Montana, Nebraska, New Hamsphire, New York, North Dakota, Pennsylvania, South Dakota, and Wyoming.

time span and as trend variables are identified. The model sought to provide the future enrollment figures for all segments of institutions and for various degree levels. A manual provides step-by-step descriptions of the computer programming procedure. The intent of the Iowa Model is given as:

> To project future post-secondary enrollments several programs have been constructed. Most of these are developed to handle specific data-analysis on a one-time basis for input into the current projection. But two are designed and constructed specifically as interactive tools to project enrollments based on the data of the other programs, and on assumptions and user given values of variables. These two programs are designed to demonstrate the way that a non-prescriptive projection program can aid decision-makers by allowing them to test alternative sets of assumptions about what the future might bring.

OBSERVATIONS

A number of observations were made during the conduct of this survey and analysis. First, enrollment forecasting at the state level is often carried out by the coordinating or governing board for all institutions rather than by the state agency for two-year colleges only. Of the documents received as part of this study, those for Colorado, Iowa, Hawaii, Texas, Oklahoma, Ohio, New Jersey, and West Virginia were from the state-wide coordinating/governing agency, not the two-year college agency.

A second observation was the absence of any state claiming a consistently successful enrollment forecasting model. On the contrary, many of the transmittal letters applauded the Florida effort declaring dissatisfaction with their own system and hoping that a more dependable one will be forthcoming.

Consistent throughout the literature dealing with enrollment forecasting and from the the survey responses is an overriding problem of limited and often

inaccurate data bases. Different accounting approaches by the institutions; absence of precise and consistent enrollment data; data representing very few variables; and resistance of institutions to supply data in some cases are illustrative of the kinds of problems identified.

A final observation is a universal desire for an effective enrollment forecasting system because of the enrollment shifts and problems encountered in various states throughout the country while at the same time acknowledging that the forecasting models of the past were primarily successful because of a growth trend and now are no longer appropriate or adequate.

The best summary statement for describing the contemporary "state-of-the-art" is reflected in the following paragraph of the 1973 study of the Florida Division of Community Colleges titled "Projecting Enrollment for Florida's Community Colleges" which seems as true today as then:

> Several problems have become apparent in reviewing the literature of enrollment projections. One of the major factors is that very little follow-up on projection techniques has been published, so that it is rather difficult to evaluate the state of the art of projection. Another more central problem is that very little has been addressed to the specific requirements demanded of community college enrollment projection. The open door policy of admissions immediately identifies a larger population pool from which applicants can derive; therefore, the method of cohort survival, which in previous years was a dependable one, is no longer as dependable. In addition, because of the role of the community college there is a wide diversity of programs and courses offered, and several objectives are recognized. If the community college is sensitive to its task within the community, it will be initiating new programs and eliminating others to fulfill student and community needs. No statistical enrollment projection techniques, based on historical trends, can anticipate the effect of these changes precisely. In addition, each community college is unique in size and rate of growth. No generalized set of assumptions can be made which will apply to all colleges. And, finally, the traditional student classification

by year (freshman, sophomore, etc.) has less meaning in the community college system. If one were to project enrollments by projecting each classification and then aggregating, there might be problems of deciding which classification to use.

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